CREATE™

Computational Research and Engineering Acquisition Tools and Environments – Ground Vehicles (CREATE™-GV)

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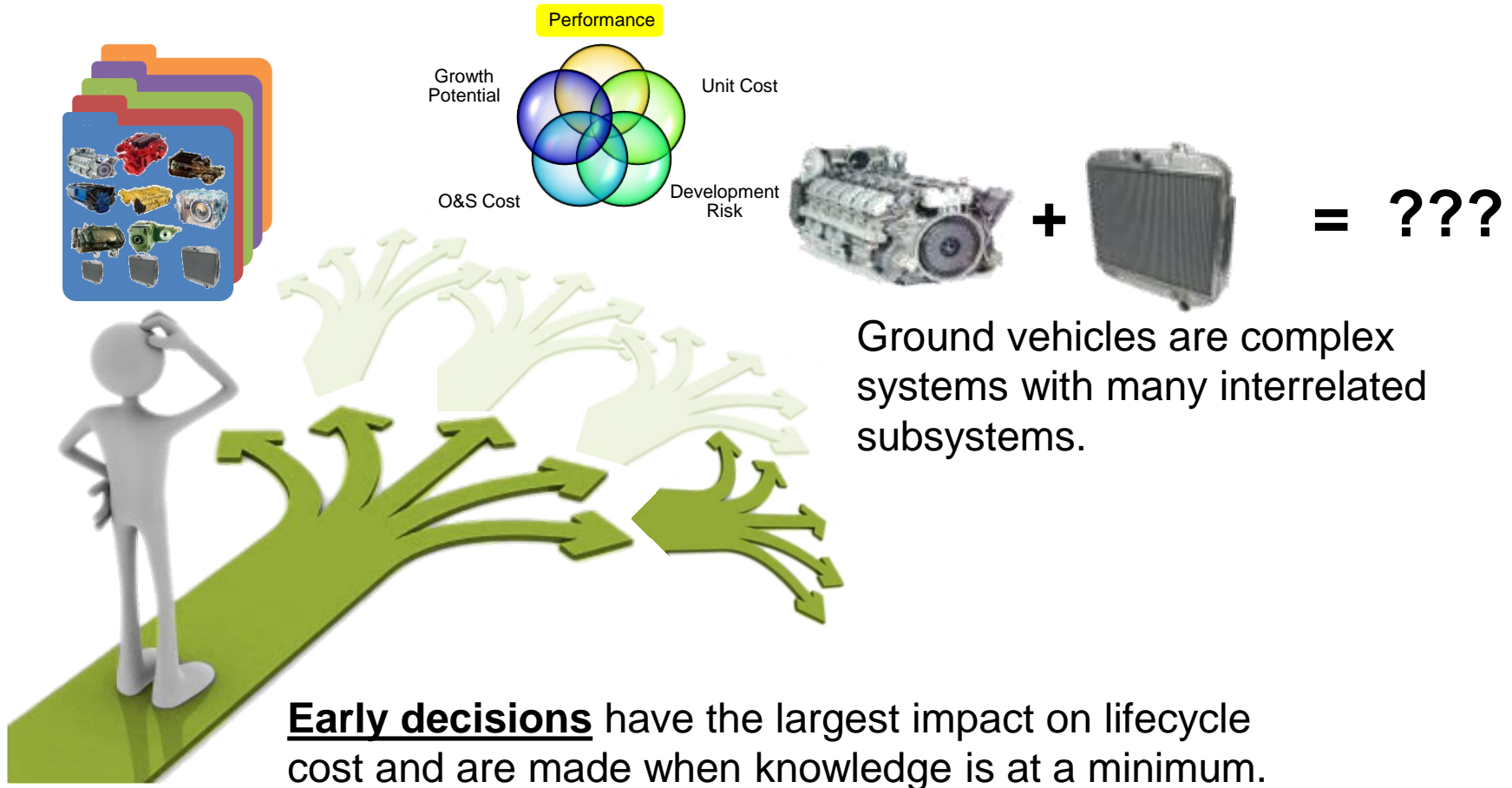**DOD HPC MODERNIZATION PROGRAM**

CREATE™-GV

Scope

Develop physics-based, High Performance Computer (HPC) tools to enhance ground vehicle concept development, inform requirements development and provide requisite data for trade-space analysis to positively impact cost, schedule and performance with significant reduction in design risk for the acquisition community.

- **Ground Vehicle Interface (GVI)**
  - User interface to provide subject matter experts and power users with simplified and intuitive access to the analysis capabilities of the CREATE™-GV tools. The GVI does not require extensive knowledge of the underlying HPC M&S.
- **Mercury**
  - HPC physics-based co-simulation tool for M&S of terrain mechanics and vehicle systems and components. Incorporates suspension, tire and track, soil modeling, and powertrain simulation.
- **Mobility Analysis Tool (MAT)**
  - Computational tool for analyzing HPC physics data and producing mobility performance metrics required for trade exploration and systems engineering. Incorporates soil condition, vehicle performance and configuration, vegetation density, average surface roughness, average slope, etc.
- **Validation and User Transition**
  - Assist in capturing and integrating user requirements into CREATE™-GV.
  - Develop demonstrations and pilot projects to provide validation of products and processes.
  - Develop documentation and training – transition software products to users.

Early Detection of Design Flaws, Reduced Development Times, Enhanced Mission-Suitable Designs

CREATE-GV Focus is on <u>Performance</u>

Finding the sweet-spot among competing objectives (**performance**, unit cost, O&S costs, development risk, and growth potential) is a non-trivial task.

Ground vehicles are complex systems with many interrelated subsystems.

Early decisions have the largest impact on lifecycle cost and are made when knowledge is at a minimum.

Capability and Gaps Document

Starting Point for CREATE^{TM}-GV Requirements

Physics Domain Gaps
from the GV Capability and Gaps Document

| ID	Physics Domain	Brief Description	GV Capability
PD-001	Propulsion	Focus on Powertrain performance	PACE, Mercury
PD-002	Mobility and Vehicle Dynamics	Focus on vehicle dynamics, off- and on-road mobility test metrics, and mission-level analysis	Chrono, Mercury, MAT
PD-008	Under Hood Cooling and Crew Cooling	Focus on cooling point considerations in powertrain performance	PACE, Mercury
PD-009	Soldier Models for Occupant Centric Analysis	Focus on design impacts upon human performance limits	Chrono, Mercury, MSU-CAVS support

Current Architecture

Diagram components:

CREATE-GV User Community

HPC Portal
- Web GUI
  - Forms
  - Charts
  - Visualization
- Portal REST API

GVI
- GVI Web Service
- Bulk Storage (e.g. terrain)
- Simulation Parameters (e.g. vehicle definition)
- Tradespace Tool Adapter

HPC System (Topaz)
- **Mercury (Physics Co-simulation)**
  - Vehicle Dynamics
  - Other
  - Driver & Controls
  - Vehicle-Terrain Interface
  - Powertrain & Cooling
- **Mobility Analysis Tool (MAT)**
  - Performance Tests
  - Tactical Mobility

HPC Direct Access (Power User Alternative)

External Tradespace Tools
- Engineered Resilient Systems (ERS) Tools
- Others

Legend:
- Ground Vehicle Interface (GVI)
- Mercury
- Mobility Analysis Tool (MAT)

Key Computational Tools

Mercury

- Simulates engineering performance tests of wheeled and tracked ground vehicles for proving-ground type developmental testing.
- Co-simulation framework for integrating physics domains.
  - Powertrain
  - Vehicle Dynamics (wheels and tracks)
  - Tire-soil & track-soil interaction
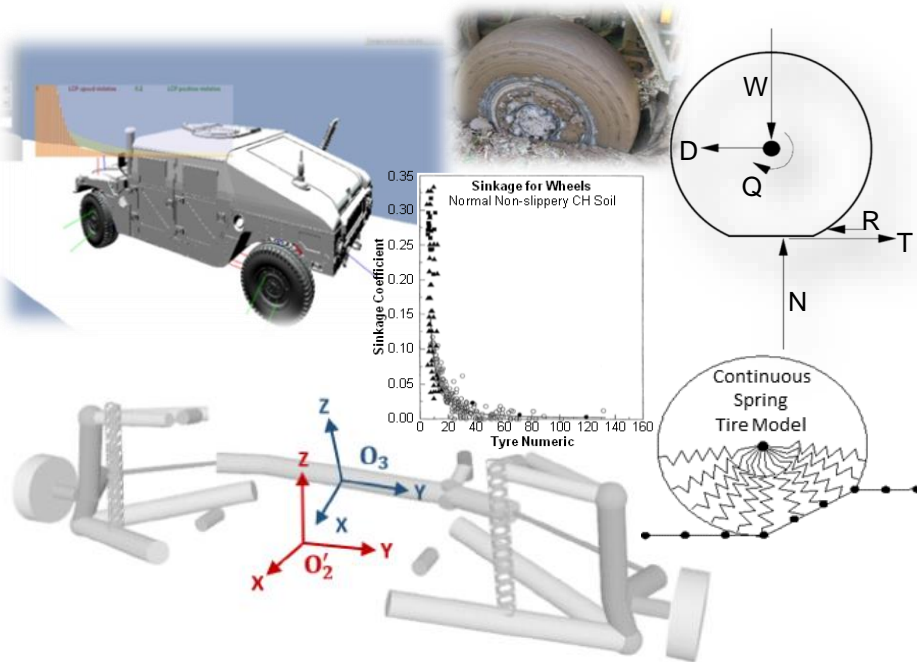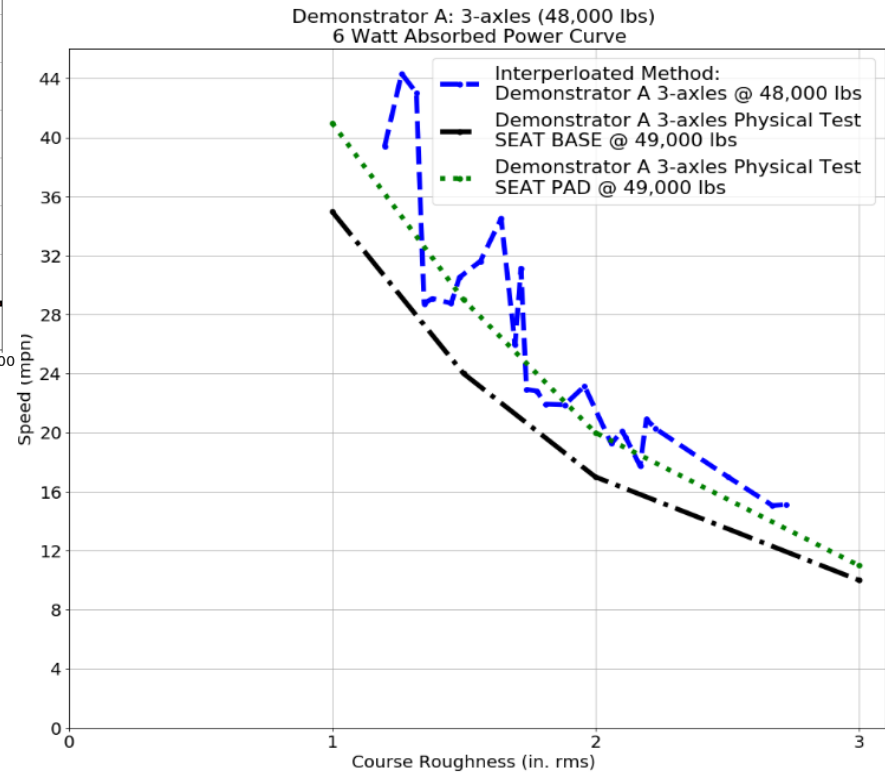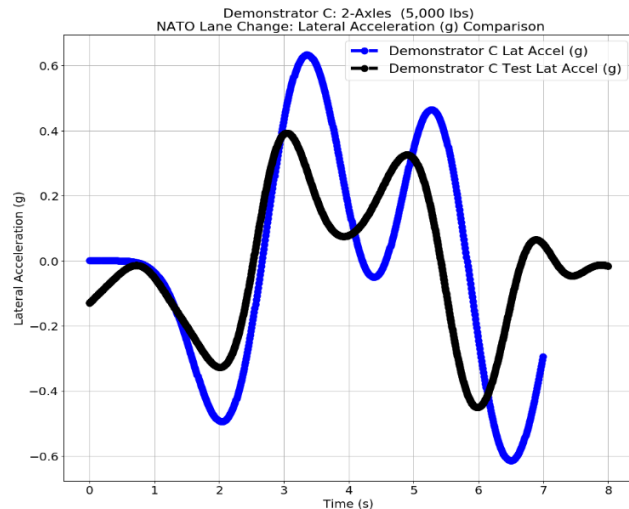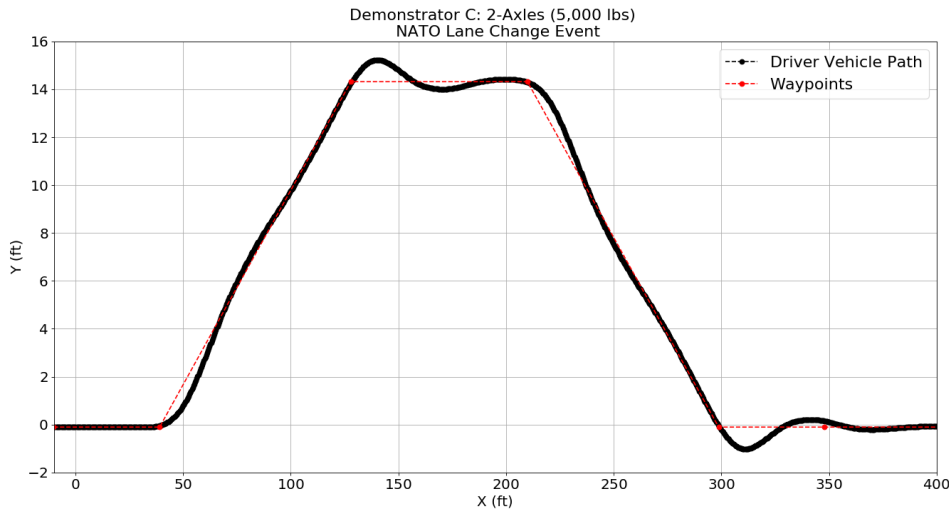
Mobility Analysis Tool (MAT)

- Converts vehicle performance metrics and terrain information into mission-based analysis of performance over large areas of terrain.
- Predicts multiple metrics currently used in acquisition processes.
  - % NOGO
  - Mission rating speeds

Mercury Input

Speed Metrics

Parameter and Performance Maps
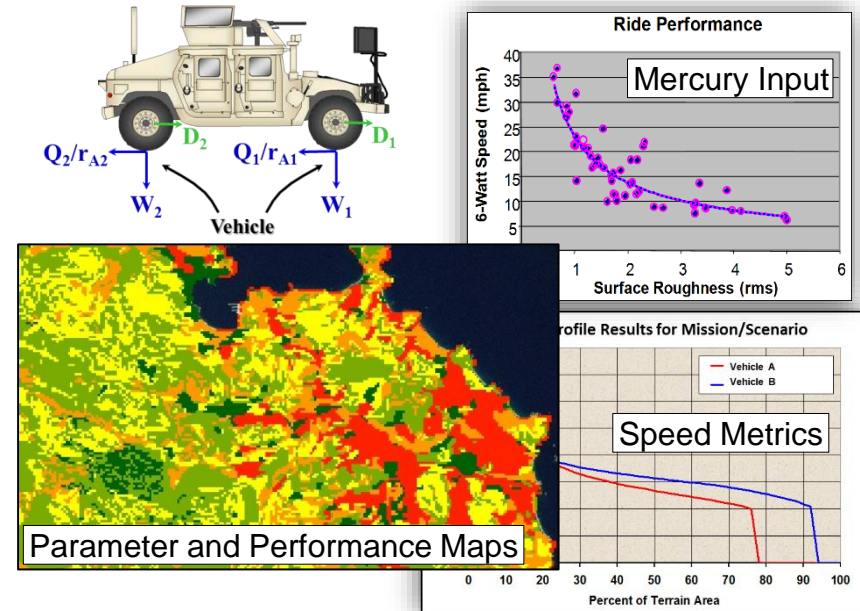
Validation and User Transition

Emphasis on validated and useful tools

- Ensure GV products provide credible results to users and key decision makers.
- Facilitate the transition from developers to the user community.

Demonstrator C: 2-Axles (5,000 lbs)
NATO Lane Change Event

Demonstrator A: 3-axles (48,000 lbs)
6 Watt Absorbed Power Curve

Demonstrator C: 2-Axles (5,000 lbs)
NATO Lane Change: Lateral Acceleration (g) Comparison
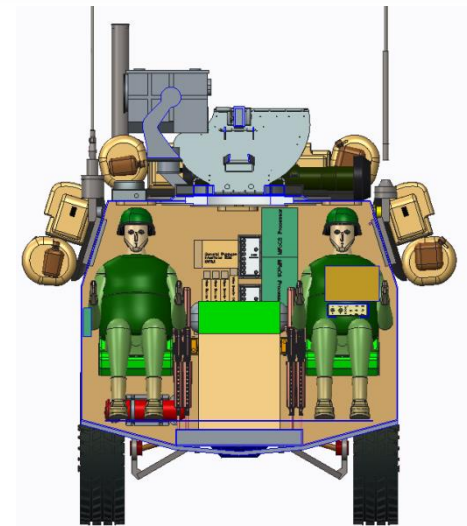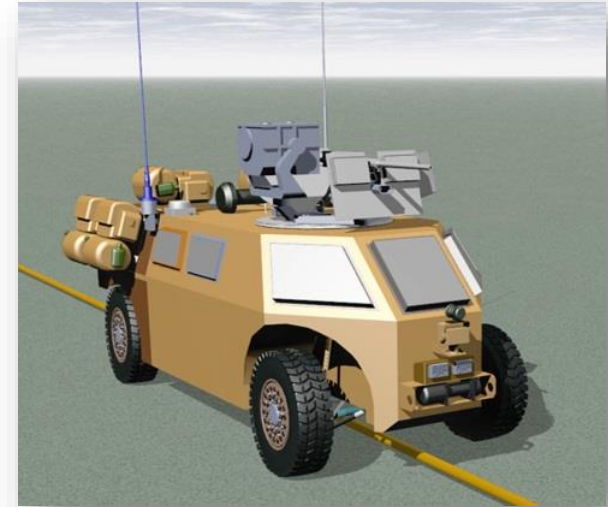
Development Partners

CREATE-GV Impacts

Engineered Resilient Systems (ERS) – Light Reconnaissance Vehicle (LRV) Pilot Program

- The GV HPC tools GVI, Mercury and MAT have been integrated to provide S&T users a simplified capability to generate the requisite data for trade-space analysis.
- Over 65,000 unique LRV configurations have been analyzed for 5 key mobility performance parameters

Future Users

- The limited early successes of the GV tools have initiated interest from various DoD users and from private industry. The tools are currently being deployed for use by key DoD government end-users with objectives for later industry use.

Thank You